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ABSTRACT

This document consists of seven newsletter issues containing the 3 year period 1989-1991. Major articles during this period have the following titles: "Special Educators Probe Promises and Pitfalls of Multimedia Today"; "NASA (National Aeronautics and Space Administration) Developed Technology for Students with Disabilities"; "Trends '89: Hardware Design Characteristics"; "Special Edition: Public Law 100-407 (the Technology-Related Assistance for Individuals with Disabilities Act of 1988)"; "Conference Summary on Advancing the Use of Technology: The Research/Practice Connection"; "Research Highlights on Technology Integration"; "Publishers/Producers: An Important Link to Technology Training"; "Update: 1990 Demographic Data." (DB)

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Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Winter 1989 Volume 2, Number 1

TRENDS '89: HARDWARE DESIGN CHARACTERISTICS

Computer Accessibility Improving for Adults . . .

But How About Children?

Computer accessibility for persons with disabilities is changing for the better, at least if the user works for the federal government. Thanks to requirements of Section 508 of the 1986 amendments to the Rehabilitation Act of 1973, P.L 99-506, all electronic equipment purchased by the U.S. government must be accessible for federal employees with handicaps. Children's advocates are watching to see if the General Services Administration (GSA)'s September 1988 regulations, which were designed largely to accommodate adults with sensory and physical limitations, will have benefits for computer-using students with disabilities. Government and industry officials are optimistic that they will.

Section 508 regulations are generally expected to result in greater numbers of accessible machines, according to GSA's Susan Brummel, and increased selection should benefit all consumers. She foresees companies with inaccessible products making needed changes to compete for the lucrative sales to the U.S. government, the world's largest computer buyer. Electronic Industries Foundation (EIF)'s Larry Scadden observes accessibility activities are underway by several manufacturers, including COMPAQ and others, a move that has not been standard within the industry and one he believes will result in future innovations. Some computer manufacturers are seeking advice from third party developers about improving access. The first "requests for proposals" requiring the new GSA standards were issued from the government departments of Commerce and State. "We may be shocked at who gets these contracts," says Scadden, who predicts new players in the marketplace of accessible machines.

Congress legislated accessibility requirements "to promote productivity and provide access to work-related and/or public information resources" according to Federal Information Resources Management Regulation Bulletin 56. Equivalent access must be available for "stand-alone" microcomputer systems and equipment that accesses mainframes and minicomputers. Acceptable solutions include third party hardware and software add-ons, built-in options, and operating system enhancements. GSA organizes solutions by functional requirement into three categories: input, output, and documentation.

Briefly, they include the potential for:

Input:

Multiple simultaneous operation alternative. Computers must provide users with the option to strike keys or buttons all at once (i.e., control, alternate, and delete) or in sequence.

Input redundancy. Alternatives are needed for users who cannot successfully operate a mouse or other fine motor control device.

Alternative input devices. Alternatives are needed for users who cannot operate a modified standard keyboard. The government wants a physical port or connection to accommodate switches, eye scan, or headtrack devices, for example, as well as supports for transparent hardware emulation for standard input devices.

Key repeat. A key repeat feature is needed for users with motor impairments to control the repeat start time and rate or turn off completely automatic repetitions that occur when a key is held down.

Toggle key status control. The government calls for an alternative mode to visual feedback to show the "on" or "off" status of a toggle key.

Keyboard orientation aids. Visually impaired users require a set of tactile overlays in the form of keycap replacements or transparent sticky tape with unique symbols to identify particular keys.

Keyguards. Motor disabled users require a keyguard template to stabilize movements and ensure correct keys are located and depressed.

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Output:

Auditory output capability. Potential for speech synthesis, including volume control and a headset jack, is required.

Information redundancy. Visual equivalents are needed for information presented auditorily.

Monitor display. This involves enhancing text size, verbally reproducing text, or modifying display characteristics. Large print may be achieved through special window-like devices with keyboards or control pads. Graphics, too, must be capable of enlargement.

Documentation:

The government wants vendors to supply documentation in electronic formats usable by employees with disabilities.

Industry and Government Initiative

GSA rules were developed in concert with voluntary guidelines of the "Industry/Government Initiative Task Force," made up of experts from various fields and convened in 1984 by the U.S. Department of Education and the White House. Coordinated by the EIF and Trace Center at the University of Wisconsin-Madison, its goal is to increase access through design information. It has urged hardware and software manufacturers to include low-cost and no-cost modifications and features that assist disabled users. Engineers and designers have advised that original designs might have been easily and inexpensively made accessible if developers had considered the need for and impact of such changes. The task force's May 1988 report on design solutions for a range of disabilities is available from the address that follows at the end of this report.

The Impact of Government Rules

Government and industry officials agree that prior to P.L. 99-506, accessibility varied considerably by manufacturers. Fortunately for educators, major players in the school marketplace, like Apple Computer and IBM, have a history of serious commitment to students with disabilities. IBM's David Keefe and Apple's Gary Moulton feel their firms will continue that evolutionary work. Other manufacturers who have shown less corporate concern about accessibility are changing their ways, notes Charles Lee, a technology project manager at Trace Center. For the first time, and since the passage of P.L. 99-506, he has observed hardware manufacturers assigning responsibility for accessibility, where in the past that assignment was left unclear or unaddressed. Manufacturers of adaptive equipment always lagged behind, Lee says, and tried to devise accessibility solutions after hardware was unveiled to the public. Lee, like EIF's Scadden, is pleased to see hardware manufacturers collaborating with third party manufacturers of adaptive equipment and operating systems in the early stages of development and procurement.

Looking for the Best

GSA's Susan Brummel believes the Section 508 regulation "sends a message to technology manufacturers to show (the government) the best that they can do." Over time, she expects to see equipment, as well as attitudes, change. Third party developers, for example, will receive more industry attention from the earliest stages in the design process. She also predicts an increased show of understanding and knowledge about disabilities and disabled users by sales persons at trade shows and retail outlets; and if inquiries are any indication, state agencies may mirror GSA accessibility requirements when their agencies purchase electronic equipment. "Handicapped employees are the first wave of creative users," Brummel says. When managers see how technology alternatives benefit their disabled employees, these solutions may be put to work for non-disabled employees, as well.

Trace Center's Charles Lee believes accessibility features provided for government employees will also benefit children. In particular, he names key repeat, redundancy, speech and communication system features, and text enlargement. He advises educators to voice their needs when purchasing equipment, question how adaptations are made and at what cost. "No child should be banned from education because they cannot use the computer," Lee says.

To Build In or Not to Build In?

Opinions are divided as to whether or not computer accessibility is preferable as a built-in feature or provided through attachments. Charles Lee likes the former, but for now, EIF's Scadden prefers the options available when computers with alternative input and output access ports accommodate adaptive equipment. Still others believe flexibility might best be achieved through standardized cables, keyboards, and the like, but Scadden sees little chance of that.

Even without general product uniformity, Section 508 will inspire a wider variety of manufacturers to meet the needs of users with handicaps, says Apple Computer's Gary Moulton. This surely will cut "the time and effort it takes a person with disabilities to find the right equipment," he says. Moreover, non-disabled users will have a greater opportunity to see how technologies are used by special populations and seek new options for themselves.

According to Bill Adler of Street Electronics (speech synthesizer) and Steve Gensler of Unicorn Engineering (expanded keyboard), for the first time some third party developers have been contacted by vendors who sell to the government. These vendors include Unisys, Wang,

and Zenith, among others. It is unclear how vendors will resolve current accessibility problems, but clearly changes are underway. Experts agree that educators will need to keep abreast and consider how innovations provided for adult government employees will find their way into schools for students with disabilities.

Implications for School-Age Children

In February, 1989 a telephone conference was held to discuss implications of the GSA regulation on school-age children. A lively discussion among panel members has been synthesized below.

Panelists for the conference were: **Susan Elting**, **Elizabeth Lahm**, and **June Behrmann** from the Center for Special Education Technology; **Sara Brandenburg**,an Augmentative Communication Specialist from St. Luke's Hospital in Iowa; **Donna Craighead**, Project Editor of microcomputer software, DLM Teaching Resources in Texas; **Roland Hahn II**, Director of the Special Education Regional Resource Center and the Pennsylvania Assistive Device Center; and **Joel Mittler**, Assistant Dean of Long Island University's School of Education in New York.

Some Specific Implications

Panelists agreed P.L. 100-407 requirements will hasten the pace at which accessibility is achieved for all age groups, although adult users are expected to benefit first. Attitudes toward successful disabled users of technologies are also likely to improve. Panelists felt the rules have special value for handicapped employees with good intellectual skills who are likely to increase their chances of employability, independence, and self-esteem. Before this can happen, however, schools need to ensure that students, especially youth in transition, have sufficient instruction and practice to become competent users before they enter the work world. Benefits to mildly handicapped users who do not have a sensory or physical impairment or individuals with limited intellectual abilities seemed unclear or, regrettably, were unaddressed.

Ease of Use is Essential

Hopes were high that the GSA required alternative for electronic documentation would result in easier to use computer systems, a crucial factor if teachers are to embrace computers as instructional tools. Currently, panelists felt teachers find computers "unfriendly," which partially accounts for their unpopular status. Even simply operated systems or software sometimes are offset by confusing or inadequate written instructions.

The simplicity of use provided by built-in features was also valued for teachers. Panelists advised against relying on adaptive equipment to achieve accessibility. Since schools own few "add-ons" now, they will probably not buy them in the future. Moreover, at 64K, the limited memory of most classroom computers is often needed for increasingly sophisticated software, thereby limiting the potential to use add-on devices. Panelists cautioned, however, that if machines with built-in features are too costly, schools will not trade up, and accessibility may be left to chance. From a monetary standpoint, one panelist felt the cost of accessibility is best spread over the entire marketplace through built-in features rather than cause special users to bear the additional expense of add-on devices.

Beyond ease of use, panelists agreed teachers need incentives, such as release time, pre-service and in-service training, and other forms of support, if they are to use technology successfully with students. Information, sufficient quantities of friendly equipment, and regular opportunities to learn and apply new skills are essential, panelists said.

How to Buy Accessible Machines

Administrators and policy-makers also need accessibility and funding information, often in short supply, in order to maximize technology purchases. Parents, too, could be more informed. These consumers are often unaware of technology's potential or don't know which questions to ask when deciding on a computer system. Panelists feared that lacking accessibility information, uniformed school districts might make economically sound "joint purchases" that needlessly fail special users. To complicate matters of choice, panelists recalled the early days of the software marketplace and wondered if an array of poor quality adaptive equipment would spring up to help contractors cheaply meet new government standards. In contrast, they wondered how to publicize high quality, cost-competitive products that are not selling well.

Spreading the Word

No one was sure whose responsibility it is to provide accessibility information to end-users. One potential source is state-wide planning committees set up as a result of the Technology-Related Assistance for Individuals With Disabilities Act of 1988, P.L. 100-407. Another idea included professional associations who were criticized for reaching too small an audience, largely the persons already committed to technology use. Other viable communication channels include teacher training institutions and regional resource centers. Producers of technology, too, could take a more aggressive role to demonstrate how products benefit users with special

needs and how adaptions for the handicapped benefit non-disabled users. Federally-funded special technology projects such as CEC's Project RETOOL and this center were praised for their national education and dissemination roles but were seen as too small to carry the responsibility alone. While additional legislated requirements were considered so that all federal funds would be required to be spent on accessible equipment, panelists feared that could cause a backlash against individuals with handicaps. Panelists agreed that without backing from top officials in state agencies and local school districts, accessibility would continue on a slow, jagged path.

What Software Changes Are in Store?

Once hardware in schools contains built-in features and expanded memory, panelists predicted more software would be produced with the flexibility in features needed by disabled students. Updated machines would free schools from a two-year lag that exists between what is current and what's currently in use, one panelist said. In the best of worlds, the built-in speech feature would result in a wider choice of products offering speech. Infra-red transmission and reception would increase access for certain physically handicapped users. Programs incorporating artificial intelligence, animated graphics, fiber optics, and the ability to control visual displays would become a reality for users with and without handicaps. Many more programs would include evaluation components that tell users about training effectiveness. One caution was expressed that since add-on equipment is a reality now and for the future, simultaneous inclusion of better defined standardized input ports on hardware, would benefit developers and consumers interested in access.

Resources

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Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Spring 1989 Special Edition

SPECIAL EDITION: P.L. 100-407

Congress Moves Assistive Technology Forward

A majority of the nation's state rehabilitation and education leaders have stepped forward to plan for the long-term to increase citizen awareness about assistive and adaptive technologies, stimulate public and private services, and help provide devices for children and adults who need them.

With the April 12, 1989 publication of the proposed regulations for the Technology-Related Assistance for Individuals With Disabilities Act of 1988 issued by the U.S. Department of Education, governors are naming lead agencies, convening planning committees, and readying their states to compete for new technology dollars.

The law, P.L. 100-407, is based upon findings that advances in modern technology can give some people with disabilities greater control over their lives; increase participation in education, employment, family, and community activities; and otherwise allow citizens with disabilities to benefit from mainstream opportunities. Congress passed P.L. 100-407 with the intention that children and adults would receive devices for their daily personal, educational, and work-related activities without having to relinquish the equipment or limit their use to particular environments. P.L. 100-407 does not replace or reduce funding but must supplement technology-related assistance provided under the Social Security Act (Titles II, V, XVI, XVIII, XIX, or XX), The Education of the Handicapped Act, The Rehabilitation Act of 1973, or laws relating to veterans' benefits.

. . . children and adults would receive devices for their daily personal, educational, and work-related activities without having to relinquish the equipment or limit their use to particular environments.

For FY89, Congress has funded Title I of P.L. 100-407, the state grants program, at $5.1 million to enable eight to nine states to develop and implement "consumer-responsive programs." These will help citizens acquire information and obtain assistive technology devices and services. Participating states will be chosen through a competitive process and judged on their ability to plan comprehensive statewide programs that, among other activities, coordinate the state agencies with federal programs and public and private entities that provide technology-related assistance. Funds will go to increase awareness, expand services to consumers, and extend the effectiveness of activities funded through other sources. States also must ascertain which of their policies promote or impede technology assistance. Moreover, states must help to increase

- the availability of funding;
- awareness and knowledge about technology's efficacy by users with disabilities, their families, employers, insurers, and service providers; and
- the capacity of public and private entities to provide technology-related assistance, particularly assistive technology devices and services, and to pay for their provision.

In FY90 some 16 states will join the competitive grants program and remaining states would follow the year thereafter. Initial three year funding is set at a range of $500,000 to $600,000 with a two year optional extension possible for a total of five years of funding. To help states meet their goals and remaining states enter the program in the second and third years, a technical assistance contract will be let in FY89.

Future Funding Looks Secure

Capitol Hill sources believe second year funding for P.L. 100-407's Title I is likely to jump to $10 million, according to Fred Weintraub, Associate Executive Director for Governmental Relations at The Council for Exceptional Children; and Title 2, which supports a variety of discretionary activities and studies of national significance, might also receive "a couple of million dollars" in FY90.

A Project of The Council for Exceptional Children
Funded by The Office of Special Education and Rehabilitative Services, U.S. Department of Education

Weintraub shared predictions with representatives from 39 states and the District of Columbia April 26 at a Washington, DC state forum sponsored by this Center on the "Delivery of Technology-Related Assistance to Meet Student Needs."

Indeed, "long-range federal involvement in supporting technology for individuals with disabilities will be sustained, expanded, and eventually become commonplace," Senator Jim Jeffords, R-Vermont, told audiences around the country that same week in a satellite teleconference on assistive technology sponsored by Education Turnkey Systems and the Central Educational Network. Both the teleconference and this Center's activities are part of a long term commitment to technology by the Office of Special Education Programs.

"Because the support for P.L. 100-407 was so widespread – in Congress, in the White House, in the Department of Education, and especially throughout the country – I anticipate that funding for this law is secure," Jeffords said, and will not be affected by budget freeze discussions, unless they call for across the board cuts. "If freeze discussions focus on selected programs, because of its popularity, this law may well be spared," Jeffords noted in the telecast to more than 250 public television stations.

The proposed increase to some $10 million is "the largest increase in the entire Labor/Health and Human Services/Education budget," said Senator Tom Harkin, D-Iowa, a principal sponsor of P.L. 100-407 with Senator Jeffords and the chairman of the Senate education appropriations subcommittee. While he is committed to deficit reduction, he values spending efficiency. Congress has found " . . . another way to achieve savings is to invest in those areas that are cost-effective and save taxpayers' money in the long run. We all benefit when persons with disabilities are allowed to contribute – and that's what assistive technology devices help them do," he advised in the broadcast.

". . . another way to achieve savings is to invest in those areas that are cost-effective and save taxpayers' money in the long run."

In addition to P.L. 100-407, Senator Harkin and his colleagues have sponsored amendments to the reauthorization of the Older American Act which will make assistive technology more readily available for senior citizens and this year he will reintroduce a bill to amend the Internal Revenue Code to allow businesses to deduct (in the year in which expenses are incurred) the full cost of acquiring or modifying equipment that help them employ elderly or disabled persons.

Yet, to its sponsors, P.L. 100-407 provides more than funding. "The power and potential of P.L. 100-407 is not its funding," Senator Jeffords said. "It is the effect the law will have on other funding – the effect it will have on the behavior of public and private agencies and organizations that now provide or could provide technology-related assistance to people with disabilities."

The Importance of Coordinating Public and Private Entities

In determining which states will receive P.L. 100-407 development funding, the proposed regulations issued by the Secretary of Education included seven selection criteria. The final regulations are expected to contain changes in the weighting of these criteria. The selection criteria and points include:

1. inclusion of individuals with disabilities and their families or representatives (20 total points);
2. coordination among state, public, and private agencies and organizations that will result in the broad scale participation and exchange of information necessary to implement a statewide consumer-responsive program (15 total points);
3. evaluation plan (15 total points);
4. goals and objectives (15 total points);
5. plan of activities (15 total points);
6. management plan (10 total points); and
7. needs assessment (10 total points).

The applications for the first round of P.L. 100-407 grants were released on May 24, 1989 with proposals due on July 24, 1989. The first awards should be announced by September 30, 1989. The Education Department plans a balance by awarding funds to states in differing stages of development and in a geographically equitable distribution, according to the proposed rules. Grants will be based "on the so-called discrepancy law," said Betty Jo Berland of the National Institute on Disability and Rehabilitation Research (NIDRR), the office that administers the program. "That is, your assessment of where you start, your goals of where you'd like to be and the reasonableness of your plan for getting there – (as well as) the likelihood of your accomplishing those steps and getting to those goals," she told officials attending this Center's state forum. Awards will not depend upon who has the biggest need, but whether a state shows a "good understanding" of its problems, needs, and potential solutions.

Berland later said that publishers and developers of technologies could take a role in their state's planning efforts

by contacting their governor's office or the designated state agency. By early May, some twenty states had named a lead agency, she said, and about ten other states have indicated they would follow suit and apply for funds. Even in states where the application may not be made in the first year, Berland said, agencies are vying to become the state's designated lead and technology-related activities are underway. Thus far, many states have named departments of rehabilitation as the lead agency; others have named their department of education; and some states have involved institutions of higher education.

No matter which agency is made responsible, participating states will have to address Congress' findings that there is substantial need for information, training, and financing for assistive technologies. Overall, Congress recognized that creativity will be needed to combat disincentives that currently exist for the private sector and limit their investment in special technologies. The states, meanwhile, will need to overcome long-standing obstacles – the lack of access and availability of devices and services – that were cited during public testimonies and in committee reports accompanying P.L. 100-407. The outcome is expected to be an overhaul of existing service delivery systems that currently leave people with disabilities without a "single agency, no one individual, or one system that will ensure appropriate assistive technology devices and services" throughout his or her life.

The disabled community and their advocates will be watching to see whether or not past turf battles and confusion over who will provide and pay for devices and services for particular clients can be resolved so that each state's "coherent, comprehensive, coordinated system" and capacity to serve citizens using funds from all sources can be established.

Successful History And Service Delivery Models

Special educators can take a key role in assuring the success of P.L. 100-407 in their states by sharing their knowledge of assistive devices and successes with various service delivery models, according to Susan Elting, this Center's director. Educators are in the unique position to help fulfill the promise of this comprehensive legislation that aims to serve people of all ages – infants, children, and adults. Educators and related services professionals often have the first opportunities to introduce young people with disabilities to technology as a life-long tool, she said.

Educators are in the unique position to help fulfill the promise of this comprehensive legislation . . .

Technology use in special education recently won high praise in a 1988 report from the prestigious Office of Technology Assessment, a nonpartisan analytical agency of the Congress. In its report Power On! New Tools for Teaching and Learning, investigators found that some of the nation's best examples of how technologies are used in education are occurring with students who have handicaps, said OTA's Linda Roberts at the state forum. A result of the 30 year interest by the Congress and federal Department of Education for assistive, as well as instructional, technology in special education, OTA observed that accomplishments of students with disabilities were exceptional when compared with general education technology. She noted "compelling evidence" over time that technology enhances cognitive abilities, allows individuals with disabilities to participate in the mainstream, and opens new opportunities for learning and interacting in various settings. Without a teacher, however, she told the state forum, "the technology falls far short."

States, too, have developed unique special education technology projects and programs. The versatility of these distinctly different service delivery systems and their history of success can help make P.L. 100-407 work, Elting noted.

Technical Assistance to State Projects

To increase the likelihood that P.L. 100-407 works as intended, the federal Education Department intends to award a technical assistance contract to an organization that will provide the highly specialized expertise needed to support state programs. Activities will focus on technical assistance, information exchange among funded grantees and unfunded states and the public, data collection, consumer involvement, evaluation, and technology assessment. Under Request for Proposal 89-056 issued in May, public and private organizations, including governmental agencies, universities, non-profit agencies, and rehabilitation institutes can apply.

The contractor's primary role is to provide individual technical assistance to state grantees. A standby network of technical assistance consultants will be established. Through state-specific technical assistance plans (TAPS), the contractor will match expert consultants and information resources to the needs of the State. State technology grantees will meet annually to develop comprehensive plans. The contractor will arrange a series of consultations to provide the needed technical assistance to the funded sates. In addition, each year the contractor will conduct a Leadership Training Institute for project directors in funded states and a National Meeting for all

states on development of technology-related assistance programs.

The contract also calls for quarterly newsletters on technology-related issues, resources, and accomplishments. These will contain important announcements related to P.L. 100-407, exchanges on "best practices" and items about state activities or other "newsworthy developments." In addition, an "on-line" bulletin board will be created for all states, expert consultants, and organizations participating in national meetings and technical assistance activities.

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For information on grant and contract applications contact Betty Jo Berland, National Institute on Disability and Rehabilitation Research at 202-732-1139 or the NIDRR Peer Review Unit at 202-732-1121 or 202-723-1198 (TDD) or write NIDRR at the U.S. Department of Education, 400 Maryland Avenue SW, Washington, DC 20202-2601.

For information on the "Video Teleconference on Communication Aids and Devices for the Disabled" sponsored by Education Turnkey Systems, Inc. and the Central Educational Network, contact your local Public Broadcasting Service station or Education Turnkey Systems, Inc., 256 North Washington Street, Falls Church, VA 22046, 703-536-2310.

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Report on Technology in Special Education

Winter 1990 Volume 3, Number 1

CONFERENCE SUMMARY ON ADVANCING THE USE OF TECHNOLOGY : THE RESEARCH/PRACTICE CONNECTION

The Center for Special Education Technology at the Virginia-based Council for Exceptional Children convened a group of researchers, software developers, and practitioners who are experienced with special education and technology for a 1989 symposium devoted to the challenge of moving technology-related research into practice. Among their findings: Barriers to technology use by teachers and students are being overcome but need diligent attention. Overall, optimism runs high that technology's potential will gain recognition as a tool to increase educational access, participation, learning, and socialization skills.

At the Washington, D.C., meeting, participants examined the small but growing knowledge base that researchers can build upon and developers might utilize to improve products. Applying research results to classroom practice will continue to be a challenge; yet special educators are optimistic that communication and collaboration can help overcome the distance between theory and what goes on in the nation's schools. The following report briefly summarizes ideas from selected formal presentations as well as reactors' comments:

SECTION I
MOVING TECHNOLOGY RESEARCH INTO PRACTICE

This section briefly summarizes the ideas, not necessarily research-based, from selected formal presentations. The presenter's name and affiliation follow each section.

Overcome The Barriers

Special Educators Can Break The Barriers

As a group, special educators are more willing and capable than their regular education counterparts to embrace technologies for the purpose of advancing learning. Special teachers are less fearful of technology and often expect to be involved with it because exceptional students come to learn with hearing aids, wheel chairs, and other equipment. Special educators are curious about new educational developments since the education of students with disabilities requires them to develop a repertoire of educational approaches and give due consideration to alternative methods of instruction.

Because the field is relatively new and still emerging, teachers are younger and less tied to old ways or resistant to change. The way they both arrange classrooms and carry out instruction departs from traditional practice. They operate with unique, modified, or different educational materials and courses of study. In training they are taught to appreciate "good behavioral instruction" which they recognize in effective software. They tune into detail and are trained in data collection. In total, they "do what it takes," to educate their students and if that should involve technology, they are more willing as a group than other educators to give it a try.

Joel Mittler, Associate Dean, School of Education, Long Island University, C.W. Post Campus, Brookville, NY

Tap The Wisdom Of End-Users — Early

Special Educators Should Pilot Software Early In Development

Teachers experienced with technology and special students want the opportunity to take emerging software products and help them along. Currently, nearly all software products purchased by this cooperative education unit are treated like most regular education curriculum materials that must be adapted before they can be useful for special students. Instead, teachers of students with disabilities want developers to pilot and evaluate new products during development or research

phases. In return, she predicts end products will be superior because they will offer the flexibility that a wide variety of learners require.

Harriet Copel, Teacher Coordinator, Microcomputers in Special Education, BOCES 2, Suffolk County, NY

Educational Research/Products Must Not Be "Teacher-Proof"

Educational researchers create big problems by excluding teachers from planning and thereby devalue their opinions. "The more we leave them out as collaborators in defining our questions, the more we try to 'teacher-proof' software, the more we isolate the credibility of a research study," according to the director of the Boston public schools special technology center. In addition, researchers appear unaware that the conditions under which research is conducted raises questions for educators. "How real-world are four kids? I'm responsible for 13,000 . . . and four kids doesn't have a lot of credibility to me nor do seven teachers in a study, nor do 70 hours over two years. I think the real world and the real conditions out there are not like" those for single research studies.

While researchers and practitioners lack mutual understanding, some things are improving. Researchers are "out there in the trenches" getting more involved with kids and teachers. Pugliese, however, criticizes a "terrible judgmental tone" expressed in the research results. When conclusions state that teachers "make few attempts," are "content to let the computer stand alone," "fail to become involved in the process," are "unwilling to prepare," that is only one perspective on a problem. "I don't know teachers that are unwilling." Most are pressed for time, shoulder enormous responsibilities, and often lack the support needed to utilize research findings in their settings. Together, researchers and practitioners need to work together to plan questions, make research meaningful, and come up with constructive suggestions that teachers find palatable.

Madelaine Pugliese, Director, Special Education Technology Resource Center, Boston Public Schools, MA

Tackle The Heart Of Training Problems

Cure What Ails College And University Faculty

A study conducted at institutions of higher education a few years ago shed light on reasons why the state of practice has moved at a slow pace. Researchers found that teacher trainers were versed in technology use for personal productivity, but lacked sufficient knowledge of applications to train teachers how to use microcomputers with children. How might this problem be addressed? He suggests five potential solutions for overcoming barriers to utilizing technology in schools and recommends a way be found to address them in a timely fashion.

1. Develop certification standards in special education technology.
2. Develop and validate competencies for teachers as well as specialists in special education technologies.
3. While in training, require introductory courses in computer "literacy" and then infuse computer competencies across preservice curriculum (or in-service training).
4. Work diligently to retrain larger numbers of university faculty and in the process develop and share expert training materials.
5. Disseminate findings about successful practices.

A. Edward Blackhurst, Professor, Dept. of Special Education, University of Kentucky, Lexington, KY

Make Communication Work Both Ways

Publisher Wants Information About What Works With Kids

If only educators and researchers could share with publishers specific strategies they know work well with learners. Such information is needed to help publishers "know where to go" next. For example: Do adorable dancing bears help? Are "time-outs" beneficial or punitive? Publishers face dilemmas because they must build in features they know sell a product, yet lack firm grounding in research. "Remedial loops," for example, may be valuable for only half the students who use them. This software publisher decries research based upon dated findings. "An article written in 1989 should not quote articles written in 1981," a time when the marketplace offered less sophisticated and reliable products. Instead, she advises, concentrate on specific conclusions such as one by a research team that found reinforcement differs for learning disabled and regular kids. "We [publishers] really want to try and change," she said, and might do so if communication from researcher to publisher and teacher to publisher would identify and substantiate preferences.

Rosie Bogo, President, Hartley Courseware, Diamondale, MI

Ideas For Improving Products Are Out There

Let's Get Smarter About What Computers Can Do For Educators

Future development of technologies and their products should be based upon knowledge of what computers can do better than teachers and what teachers can do better than computers. Don't create new software that duplicates what teachers can and want to do, suggests this education director. Do give us technology that can replace time-consuming tasks, such as clerical duties, or instruction involving "flipping cards" and "flash drills" that a computer can do as well as a teacher without usurping control of the curriculum.

White and his coworkers praise software that allows students or teachers to decide what they will learn about next. He prefers choice, such as the option to print out missed terms with graphics, but only if desired. Program designers who are honest and will "fess up" and say, "Gee, maybe this program isn't helping Johnny," are best. White believes that technologies must aid all learners, special and mainstream, so as to be adopted quickly by regular education teachers who are working with special children.

Owen R. White, Professor and Director, University of Washington, Experimental Education Unit, Seattle, WA

What Schools, Teachers, and Students Need

Research in regular and special education has shown that students are successful and feel independent when they use the computer as a writing tool, especially when instruction is delivered by teachers skilled at teaching the writing process. To be effective and overcome writing barriers created when pencil and paper are used, youngsters must work on computers a minimum of three times per week. Teachers, too, need proper working conditions and support for specifically teaching writing, using technology, and understanding special students. In order to develop effective future products, research is needed to create supplementary tools that will analyze the mechanics of generating, composing, and revising a student's written work. A spelling checker is needed that tracks and characterizes particular problems over time. Why not develop a software product capable of printing out a graph that shows a student's progress on targeted errors? Also needed are visual representations of individualistic changes in children's revisions.

Bridget Dalton, Research Associate, Education Development Center, Newton, MA

Continue The Research

Technology Is Working, But We Need More Time

The small but growing body of special education research shows that when a student uses technology and the teacher is involved at any point either before, during, or after time on the computer, the effects can be positive. In order to be effective, however, teachers need a diverse set of competencies so they can link technology into complex learning, a process that includes assessing students, observing, setting the context for instruction, teaching, reflecting on student performance, intervening as necessary and linking the computer activities to broader goals. Continued study is necessary to learn exactly where technology can make a difference and how it fits into complex learning and teaching. "We have little whispers. We have powerful examples, but we don't know ... it all yet and we need more time. We're learning a lot."

Catherine Cobb Morocco, Associate Director, Education Development Center, Newton, MA

SECTION II
VIEWING THE STATE OF THE RESEARCH

This section briefly summarizes research issues and findings on individuals with severe handicaps.

Individuals With Severe Handicaps: More Capable Than We Imagined

Innovative educational practices and creative research with powerful tools have resulted in a new perspective on individuals with severe handicaps: They are more capable than we imagined, have strong preferences, and can make definitive choices. Equally important, these persons have sophisticated social systems and can work meaningfully in competitive employment when given some supports. Researchers caution, however, that unlocking their potential may depend upon our understanding that the preferences of persons with disabilities may differ from nondisabled peers. As a result, various flexible options are needed in hardware and software products to ensure efficient access to the environment. Meanwhile, research continues to reduce the mental load that hardware or physical surroundings place on these individuals and to increase the speed of their interaction in daily life and with others.

". . . you can't necessarily assume the thing which is faster for nondisabled individuals is going to be necessarily faster or more efficient for disabled persons." Cynthia Cress

Despite certain differences from nonhandicapped peers, research results with "low incidence" populations also shows an upward generalization – what works to minimize limitations of severe handicaps also increases the speed and decreases the burden for less impaired individuals and very young children. Techniques that make the computer faster and better for students with disabilities has had the same result for nondisabled peers. Other important findings have shown that various minimal cognitive abilities are required to ensure effectiveness in using equipment because different access techniques have different effects on "cognitive load."

Among these findings presented at the conference are the following:

Access To Instruction

- Cause-and-effect research with babies as young as 3 months old show there is no age at which computers are not functional for certain tasks.
- Optimal use of the touch screen seems to begin at 2 years and the minimum cognitive level for using a mouse is between ages 3 and 4.
- An unlikely choice in equipment may be faster and better for a user than a more obvious selection if the disabled person has psychological or social reasons for preferring it.
- Access that limits the computer system solely to a student with disabilities is not likely to gain acceptance in school systems.

Augmentative Communication

- With exposure and practice, listeners generally learn to interpret the accent of electronic speech. The consistency of synthesized speech may be especially effective and aid learning for very low functioning individuals.
- There is no prerequisite for communication.
- Symbols can be understood at an early age.
- Rate enhancement training may allow the user to communicate faster, but may require greater effort than the results warrant.

Graphics

- Typical graphics found in CAI are not always appropriate for persons with severe cognitive and linguistic disabilities due to limitations in the user's ability to connect what is represented to real life and related problems of visual closure.
- Graphics may play an important role for the disabled population in providing instruction, stimulation, reinforcement, cuing, and linkage with a communication system; however, more research is needed on the effects of using pictures in light of this population's cognitive and linguistic limitations.
- Consistency in providing particular graphic features such as size, color, and photographic quality versus other visual representations may be more important than making assumptions that there's a workable graphic hierarchy.
- While matching pictures begins at just a few months, the concept that pictures convey information is firmly established between 2 and 3 years of age. Not until children are 7 to 9 years do they deal with picture information of a complex nature. Armed with this information, researchers can now begin to explore the ramifications of providing graphics-based information to students.

Software Features And Information Feedback

- Speech synthesis for some individuals with severe disabilities is perceived by them as "noise," and therefore is not an effective stimulus for eliciting responses or for reinforcing behavior.
- Persons with severe intellectual handicaps use few cues in responding to other persons, and the cues selected are often poor choices.
- Prompts must be relevant, directly associated with a stimulus, or in close proximity to it. The most effective prompts come as an antecedent rather than a consequence and work best when they are presented but then gradually eliminated. Greater control over computer-generated prompting is essential.
- Limited response repertoires should be aided by adaptive equipment.
- Assumptions about reinforcements and their schedules must not be made with handicapped populations but determined through sampling or other techniques. Effective reinforcers have included giving verbal choices and seeking preferences in screen design or sound presentations.

- Stereotypic behaviors such as a tapping pencil or shifting from place to place interfere with the rate of learning among persons with disabilities.

Environmental Control

- individuals with severe handicaps often fall into a "learned helplessness" syndrome where they are passive rather than active agents in their world.
- Ways must be explored to overcome this syndrome as well as the deprivation that results from limited movement and human interaction.
- Assistive technology, with a proper match between equipment and the individual's needs, holds real promise for overcoming many barriers facing individuals with severe handicaps.
- A computer can be used as a reliable and accurate assessment tool for determining an individual's preferences. This allows the researcher to choose viable positive reinforcers and the individual to communicate his or her genuine preferences.

Speech Technology

- Concerns over the quality of speech output employed in various programs and devices center around issues of intelligibility and naturalness.
- Synthesized speech – speech generated by rule – is very difficult to understand in certain noise conditions and seems to raise intelligibility problems when used with students with language impairments.
- In terms of naturalness and intelligibility, the highest quality speech output can be achieved through digitized speech – human speech digitally recorded and then usually compressed in some way – but this is a memory-intensive operation which limits its practicality and also spontaneity.
- Current technology is frequently a hybrid of the two approaches.
- Little research has been done on the response of persons with severe handicaps to various forms of computer-generated speech output.

The points covered in Section II were culled from the presentations of seven researchers:

Sarah Blackstone, President, Sunset Enterprises, Monterey, CA

Carrie Brown, Director, Bioengineering Program, Association for Retarded Citizens, Arlington, TX

Al Cavalier, Associate Professor, Department of Education, University of Delaware, Newark, DE

Cynthia Cress, Project Manager, Trace R & D Center, University of Wisconsin-Madison, Madison, WI

Beth A. Mineo, Assistant Professor, University of Delaware/A. I. Dupont Institute Applied Science and Engineering Laboratories, Wilmington, DE

Alan VanBiervliet, Associate Professor, University of Arkansas-Little Rock, Little Rock, AR

Mary Sweig Wilson, President, Laureate Learning Systems, Winooski, VT

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Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Summer 1990 Volume 3, Number 2

RESEARCH HIGHLIGHTS ON TECHNOLOGY INTEGRATION

Researchers examining technology integration for diverse and special learners in mainstream classes have fresh information about computer use in elementary, middle, and high schools and insights about computer adoption at different organizational levels, such as classrooms, schools, and school districts.

Information comes from Phase I findings (1986-1989) of three ongoing research contracts funded by the U.S. Department of Education, Office of Special Education Programs. In Phase II (1989-1991) contractors are developing separate models of technology integration based on their Phase I findings. They are Macro Systems, Inc., focusing on high school learners; Education Development Center (in collaboration with Technical Education Research Center during Phase I) examining middle school learning; and the Center for Technology and Human Disabilities at The Johns Hopkins University is looking at elementary school-age students.

At the outset in 1986, project directors were asked to work independent of one another in the first three years of their research. Now midway, findings suggest somewhat different interpretations of the term "technology integration" across the three projects. Some of the variation can be attributed to the age group involved or the kind of school setting – that is, where the technology is being infused – in classrooms, throughout a school building, or at the school district level.

Final project results and products are about two years away, but much of the data, collected from either primary research or sub-studies, already verifies popular attitudes about technology's benefits for special students. Moreover, it confirms some of the enabling factors that set the stage for educational technology to be integrated within mainstream education in meaningful ways.

The following selected highlights from each of the three ongoing studies are intended to provide publishers and developers with mid-point information that can shape future products, product documentation, support services, packaging and marketing.

Integrating Technology At The High School Level

Macro Systems' research verifies some popularly held ideas about the role of technology when it is a normal and accessible part of a school or district. Implementation, for example, requires educational leadership beyond one key figure and often involving a range of school divisions and staff, including administrators as well as teachers. While personnel must be knowledgeable or competent with technology and value its use, Macro notes good communication among involved parties is also essential. Information gathering in planning for and acquiring technology, as well as plans for installing and maintaining it, are considered part of the overall process by which technology becomes integral in a school. Resources, both human and material, must be accessible. Once technology is integrated, school personnel act routinely to decide whether to use computers to meet individual needs, program objectives, or organizational requirements. Beyond that, effective integration seems dependent upon participants who clearly understand the nature of their school organization.

Macro feels, most importantly, that districts must develop a guiding philosophy or statement of goals for technology integration that reflects a flexibility and sensitivity to local conditions.

Macro's conclusions are based upon work in suburban Howard County (MD) Public Schools that has eight high schools and experience with technology integration. The other district, Chittenden South Supervisory Union, in Vermont, has one high school serving five suburban and rural towns. It is currently examining the role technology can play within its system and has made significant investments in equipment and software.

The following are selected highlights from the Macro study:

A Project of The Council for Exceptional Children
Funded by The Office of Special Education and Rehabilitative Services, U.S. Department of Education

In Administration

- Shared decisions: Often administrators make decisions, especially about equipment and training, without input from teachers who were found to have the best sense of their students' and their own needs.
- Collaborative decision-making between regular and special educators needs to be improved.
- Committee processes: School-based committees designed to deal with microcomputers appeared largely inactive. Principals and coordinators were found to make technology-related decisions independent of teaching staff.
- Communication management systems: There is very little direct monitoring or evaluation of actual computer use in classrooms. Administrators felt that surveys on technology offered as part of this study could become a tool to gain support from higher district officials.
- Policies and procedures: School boards should be included as part of a district's communication channel to help make technology-related decisions. Visible administrative support was found to encourage teachers to use computers.
- Pre-service training: School officials need to be more assertive and tell higher educators that they expect teachers be given computer-related competencies during pre-service training programs.

In Material Resources

- Hardware selection and acquisition: School boards need to make access to technology their priority, while school district leaders need to develop long-term technology plans.
- Hardware distribution and management: Both labs and classroom placement may be the appropriate distribution points, depending upon goals. Teachers, however, say they want lab settings that accommodate an entire class.
- Software distribution and management: Frequently used software should be available for loan in each school. When software is very frequently used, it should be located in classrooms. District level libraries should house software used only occasionally.
- Software selection and acquisition: The utility of software programs for older, mildly cognitively handicapped students can depend upon whether packaging appears age appropriate. While software firms are beginning to provide more information about their products to help teachers make selections, teachers relying on word of mouth may purchase older, less powerful programs.

Applications in Classrooms

- Computer-assisted instruction (CAI) appears to have important contributions to make to individualized as well as group learning. The degree to which CAI is an effective supplement to traditional instruction needs more research. CAI is especially effective in the study of science.
- Drill and practice can be effective for math, but is less valuable in reading and language arts. Only in limited ways was it found to promote skill development, retention, or conceptualization.
- Educational games have value in promoting socialization skills, although some game features may distract students with learning disabilities.
- Word processing, a favored application, helped to improve writing skills, but not necessarily the quality of writing.
- Learning disabilities may prevent some students from mastering keyboarding or understanding program functions.

Curriculum for high school students with mild cognitive impairments is similar academically to that of regular students.

For more information, contact Macro Systems, Inc., 8630 Fenton St., Silver Spring, MD 20910, 301/588-5484.

Macro Systems, Inc.

The major product of Macro's five-year research project for the Office Special Education Programs (OSEP) on technology integration will be a comprehensive manual for special educators and school administrators. The multi-part manual will reflect what has been learned during the research phase of the project. Guidelines for technology integration at the school and district level, specific implementation and management issues and solutions, and information about resources to support integration activities will be provided. The manual, designed for local administrators and teachers, will promote the sound use of new technologies in high school programs. It is currently being field tested by school districts in Phase II of the OSEP project. Publication is expected in the fall of 1991.

Integrating Technology At The Middle School Level

Researchers at the Education Development Center/Technical Education Research Centers (EDC/TERC) have examined teacher practices that create successful, computer-supported learning experiences for special needs students. Their work also has considered the larger school and organizational context that sustains those practices.

Thus far they have found that technology applications are more likely to be lasting if they occur over time, across classrooms as well as content, and as an all-school effort rather than a special interest of a classroom teacher. To the experts at EDC/TERC, computers are considered integrated when they help students connect with curriculum in a new way or when, as a result of computer use, teachers develop new teaching approaches in content areas. EDC/TERC's work has been concentrated in four diverse middle schools located in inner city, suburban and small urban sites. Some of their findings are briefly highlighted here.

Teacher Knowledge and Practice

Teachers of special students, rather than being freed up by computers, are actually required to be actively engaged as students use software. In order to improve the way technology is used with special needs students, teachers must be knowledgeable about several areas, including student strengths and needs, the benefits technology can offer, curriculum content, instructional as well as assessment strategies, hardware, and software. Effective teachers who are given time to reflect with other educators about computer use are more likely to critically evaluate their practice and redesign instruction to better meet student needs and curriculum goals.

Technology Resources

If it is to be integrated successfully, technology maintenance and repair must become the responsibility of someone within the school district who would also be available to solve technical problems. When school personnel have a mechanism in place to narrow software choices, teachers are more likely to try to integrate technology into classrooms.

Teacher Development

Teacher pairing for knowledge and reassurance, especially when novice users are involved, is consistently associated with successful technology integration into curriculum. Inservice workshops alone are not sufficient. Teachers best learn to integrate technology successfully through ongoing school-based support and structures for collaboration and communication.

School-based Facilitation

Administrative support, planned time for collaboration, and ongoing access to resources is critical to technology integration. Decisions about hardware purchase and allocation, as well as scheduling for use, should take into account curriculum goals and teacher competencies, rather than focus exclusively on issues of equity and access. Technology-related decisions must have someone committed and responsible for implementation. During the process, teachers and administrators must communicate and decide to keep on course or change plans. Administrators' expectations must be realistic and flexible allowing for teachers' individual differences with and decisions about technology use.

Other Findings

EDC/TERC also found that in order for technology to be successfully implemented beyond individual classrooms, administrators must possess vision about the value and potential of the computer to meet students' instructional needs. Moreover, they must understand that technology integration involves instructional and organizational changes. When policies and procedures promote communication between regular and special educators on curriculum matters, instructional goals, and student needs, special students are more likely to have their needs met.

For more information, contact Education Development Center, Inc., 55 Chapel St., Newton, MA 02160, 617/969-7100.

Make It Happen! Guiding Middle Schools To Integrate Technology

Make It Happen! is a model to guide middle schools through a three-year change process of integrating computers into the curriculum. The strategies for promoting school-wide change echo key recommendations of the middle school reform movement that schools should move toward collaborative planning and teaching that fosters higher order thinking in adolescents. The goals of the model are for: (1) interdisciplinary teams of teachers to design, implement, and evaluate a curriculum that uses computers to support inquiry-based learning; (2) adolescents to expand their critical thinking abilities, cooperative learning behaviors, and positive attitudes toward learning through engaging in that curriculum; and (3) principals and school-based management teams to create a supportive school context that facilitates computer integration across a school.

Integrating Technology At The Elementary School Level

In connection with their larger project goal to devise a classroom-oriented model of integrating technology, researchers at Johns Hopkins University conducted several substudies related to instructional use of computers. Sixteen studies were conducted in 50 classrooms.

The following findings relating to curriculum correspondence come from four of those studies:

Curriculum Correspondence

Seventeen special education and 21 regular education teachers from 14 schools completed questionnaires. Project staff reviewed curriculum guides and individualized education programs to examine the match between currently available software and curriculum requirements or goals. To ascertain information about curriculum correspondence, they also reviewed the Minnesota Education Computer Consortium software and software descriptions from The Educational Software Sector.

Results showed that, with certain qualifications, the marketplace offers software for every critical curriculum unit in math, reading, and language arts. A major problem exists in that this software is not always available to teachers. Moreover, catalog descriptions often can be inadequate for making software selections. Programs cover a broad age or grade level, but all too often they do not include exercises "sufficiently specific to the needs of students with mild disabilities."

Teacher Involvement

Researchers also found that computer-assisted instruction augments traditional instruction yet, to date, does not replace direct and active teacher planning. The active role of the teacher educating students with learning disabilities (LD) was considered clear along with the finding that CAI can improve levels of achievement with such special students. While exemplary software may appear to have a "stand alone" quality, teacher intervention, in the case of diverse learners, may be critical for optimal use and gains.

Instructional Approaches and Applications

In another substudy on teaching compound words, students whose teachers used specific procedures to introduce CAI had a better rate of correct responses and learned faster than students whose teacher used traditional instructional approaches. Researchers concluded that students with mild handicaps probably perform better on tutorial software programs when teachers link CAI with non-CAI instruction. Software, even if labeled "tutorial," is not sufficient on its own to teach students. Computer instruction, however, must be linked to traditional teaching using familiar materials, vocabulary, format, and teaching techniques.

A companion study using a different and larger group of students looked at applications of drill and practice software. Twelve fourth- and fifth-grade students receiving language arts instruction in resource room settings showed mixed results. Performance of some was better without the teacher's introduction; some performed better with it. But for second- and third-grade students, all performed better in both accuracy and rate when CAI was introduced by the teacher and linked to their regular instruction.

Researchers from Johns Hopkins concluded that a brief instructional link between non-CAI and CAI activities had value. This conclusion corresponded with earlier, related studies.

Patterns of Use

A final single-subject study examined patterns of use by individuals, dyads and triads. Both drill-and-practice and problem-solving software were used with two third-grade and two fourth-grade students with mild learning disabilities. In addition, four sets of three students without handicaps "acted as cohorts" in different groups. Students with a variety of skill levels showed a 89-94% level of correct response across all three arrangements made for math drill and practice sessions. Students were highly engaged, except for the triads where off-task behavior was noted.

In a study where software was used to develop collaborative problem-solving strategies and interactions in the mainstream, researchers found student groups need a greater amount of time to learn the task and develop efficient and effective collaborative strategies with problem-solving than was required during drill-and-practice activities. Interaction, both in frequency and variety, was greater during problem-solving than during drill-and-practice whether students were working as individuals or in groups.

Researchers also noted that using problem-solving software in groups gave older elementary students the chance to interact in positive ways with non-disabled peers beyond collaborative study skills they were developing. In contrast, triads executing computerized drill-and-practice went off-task because the activities failed to keep students interested cognitively and motorically.

For more information, contact the Center for Technology in Human Disabilities at The Johns Hopkins University, 2301 Argonne Drive, Baltimore, MD 21218, 301/554-3046.

The John Hopkins University Technology Integration Project

During Phase II, the Johns Hopkins University Technology Integration Project will revise the TIE model. The model gives teachers and school administrators suggestions for collaborative planning and teaching, and for ongoing school-wide support. Consumer products will provide an orientation to TIE and its conceptual framework and provide advice for implementing the model. Two manuals are planned: *A Teacher Technology Resource Guide* and *The Principals' Assistant.* Modularized training on school-based management and change facilitation for building administrators and on technology integration in the classroom for teachers are also planned.

MORE ABOUT THE CENTER .....

As a regular reader of our **Marketplace** series, you are familiar with the Center's efforts to provide more information about the special education market to those who develop and distribute technology products. The Center also provides a range of products and services to those in the special education community who use technology. We'd like you to know more about the Center and the varied services we provide.

Our general information services, aimed at practitioners and other technology users, emphasize current trends and practices for students with disabilities. The **Tech Use Guides** provide short summaries on topics ranging from *Computers and Writing* to *Augmentative Communication.* Our state and topical **Resource Inventories** list over 1000 sources of information and service for technology users.

The majority of the Center's efforts are devoted to in-depth coverage of selected topics or "themes." Current theme activities are underway to address information needs in the following areas: assistive technology, funding of technology programs and products, technology training in special education, technology applications for moderately handicapped students, and the integration of technology in special education instruction and program development. Activities within each theme are geared to filling information gaps and linking the latest research, practice, and products with appropriate audiences.

To find out more about the Center's information resources, please contact us at 1-800-873-8255.

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The Marketplace

Report on Technology in Special Education

Fall 1990 Volume 3, Number 3

Publishers/Producers An Important Link to Technology Training

If technology is to be successfully integrated into the classroom, training remains an acute need. The dramatic increase in technology available to special educators in the last few years has created a shortage of trained personnel.

At present, technology training is taught in teacher preparation programs at colleges and universities and inservice programs in school districts and at the regional level. Generally, these programs concentrate on teaching basic technology skills, although there are technology specialist programs at the university graduate level.

Professional associations offer limited training opportunities through workshops and special interest national and regional conferences. Commercial producers offer workshops in technology training at state technology conferences and disseminate product information.

Expert Trainers Discuss Training Needs

Even through many classroom teachers still need entry-level competence with computers and other media, teachers also need to focus on making technology an effective instructional tool, concluded experts at a national meeting for technology trainers in June 1990, sponsored by the Center for Special Education Technology, a federally-funded information project at The Council for Exceptional Children. There were 45 expert special education technology trainers from colleges, universities, education agencies and commercial producers who attended and shared their expertise on training.

The experts agreed that the focus of training should shift from equipment/hardware concerns to using technology to deliver curriculum. The technology should be bent to fit the teaching objectives, not the objectives bent to fit the technology.

According to the experts, successful technology training includes three essential elements. First, training must not be a one-shot event; instead it must include ongoing activities over a period of time. Second, teachers must have access to regular sources of technical assistance, such as mentors, knowledgeable colleagues, and consumer hotlines for troubleshooting. Third, teachers must have access to technology and time to review materials and experiment with how to use them.

Content of Training

A consensus exists among these special education trainers about what should be taught, what the benefits could be, and, with variation from site to site, what competencies are most needed to support education for the disabled today.

In addition, the experts found that when these skills are built upon a base of knowledge about individual differences, subject matter, principles of learning, effective instruction and special education, teachers are more likely to choose appropriate electronic tools and software for instruction with different populations and in different situations.

Trainers agreed that more information should be imparted about:

- Using assistive technology to access instruction.
- Improving access to technology information.
- Determining when and under what conditions technology should be infused into the curriculum or testing of students,
- Coping with barriers to technology implementation, such as patterns of haphazard technology acquisition or instruction.
- Providing best practices in collegiality and team building.

A Project of The Council for Exceptional Children
Funded by The Office of Special Education and Rehabilitative Services, U.S. Department of Education

Qualities of Skilled Trainers

According to the experts, skilled technology trainers must understand more about adult learning and apply this knowledge at colleges preparing new teachers, as well as at local or intermediate districts working with K-12 classroom teachers. Trainers must learn how schools adopt innovations and how teachers implement new skills. Increasingly, these trainers found that in order to produce better outcomes from their training, trainers themselves must become more comfortable with technology and infuse it into their own teaching as model behavior.

Training in the States

Several successful examples of technology training in progress across the country show promising results for special education.

Some states are mounting comprehensive training programs. The Oregon Technology Access Program, conducted by the Oregon state education agency, began its program last year and has already trained 500 teachers and parents in augmentative communication, adapted toys, use of assistive devices for computers, and use of software in special education. The state's local school administrators, regional coordinators, special education teachers, speech pathologists, and occupational and physical therapists are requesting its workshops. Follow-up technical assistance delivered on-site helps participants master and apply technology skills. A series of print guides have been produced to explain computer uses, funding, and training.

An older program, FDLRS/TECH, is a specialized center in the Florida Diagnostic and Learning Resources System (FDLRS) network. Developed to deliver statewide instructional technology services, the training includes a variety of approaches, tools, and information that have been refined over many years. Trainees come from the 18 associate and 10 specialized FDLRS centers of the Florida FDLRS network serving local districts in the state. Currently, FDLRS/TECH is developing replicable 2-day workshops on using desktop publishing in the language arts curriculum. It is also field testing "Sailing Through the Mainstream," a replicable workshop in a whole language format to help special education students who have been mainstreamed.

Other well-regarded and established inservice training programs include Missouri's active special education technology center and Michigan's transportable specialized modules.

Training Needs of Teachers and Supervisors

In order to gather more information about training needs, the Center queried teachers and supervisors of students with mild disabilities. These special educators ranked themselves from beginners to advanced in their knowledge of special education technology.

Teachers want trainers to tell them more about curriculum areas in which technology has proven useful or cite examples of effective use with specific disabilities – such as students with emotional disturbance or learning disabilities. They want to know convincing new ways that computers fit into the curriculum.

Teachers reported that old problems still exist. There is not enough equipment in schools, and districts lack sufficient technical support to deal with breakdowns. Due to the limited availability of computers, teachers are hungry for creative ways to use a single computer with groups of children.

More information is needed about models of classroom management that demonstrate graduated levels of technology integration and access, the interviewees said. They would also like to know which technology strategies help to integrate students with disabilities into mainstream learning situations. Others need information about individualizing software or restructuring classrooms to allow more time for computer use.

The respondents were very interested in using computers to develop writing, language arts, and reading skills. They wanted to know what technology offers for teaching math beyond drill and practice. The teachers also wanted more information about the best instructional methods in keyboarding.

Expertise at troubleshooting was listed as a desired skill. Supervisors would like to help greater numbers of their teachers become technology literate; they want teachers to overcome their fears of technology and their past bad experiences with equipment and software.

Experienced teachers want to learn to use networks and databases, and ways to interface the computer with projectors. They feel they have a problem keeping abreast of appropriate hardware and software as it develops. Training workshops that offer college credits would be a good incentive; however, they are not frequently available.

Teachers were critical of existing forms of information; they said software documentation and support materials are still not as useful as they should be. In addition, while

software reviews are available from various sources, these teachers didn't feel they have easy access to this information.

Training Provided By Commercial Producers

Training delivered by the private sector is important. Commercial producers can provide direct assistance to teachers with on-site workshops and toll-free telephone hot line services to answer consumer questions. Smaller firms can provide indirect assistance, such as developing support materials for training and newsletters.

Tom Snyder Productions sells a video highlighting specific classroom suggestions and examples of how to use the company's software programs. A publication called *Teaching in the One Computer Classroom*, with reproducible pages, is designed to make sharing ideas with colleagues easy. There is also a video (or an audiotape) of Snyder's educational keynote address at Applefest 1990. A "Do-it-yourself Inservice Workshop" kit with a variety of materials sells for under $30.

Mindscape Educational Software has produced two videos to help parents and teachers become more knowledgeable about software. *A Guide to Selecting Educational Software* and *Students at Risk: How Computers and Software Can Help* are free for the asking. A *Partners in Education* video aimed at helping at-risk students sells for $19.95 or comes with a free loan guarantee for 30 days and liberal duplication rights.

Some of MECC's staff development materials have reproducible pages for both management and instruction. One guide examines the use of writing with publishing software and multimedia. Costs range between $20 and $59 for the programs. Videodisc minicourses are available, as are videocassette tapes for training teachers to use computers to teach scientific inquiry, communications, and writing.

Sunburst has created a new subsidiary called WINGS to develop products that help teachers build learning environments. Print materials, manipulatives, videotapes, videodiscs, CD-ROM, and software are being designed to give classroom teachers the information they need. Another service is a free newsletter called *Strategies* that explores professional trends and effective teaching with computers in middle and high school.

A Link To Literature is a teacher-developed publication for customers of Teacher Support Software who are pursuing innovative ways to use computers to teach different kinds of literature in K-6 classrooms. Included are 12 detailed lesson plans to help teachers use software in an integrated approach to learning.

Commercial producers could supply greatly needed instructional support to integrate computers into the curriculum. Technical assistance via an 800 phone number could be used by teachers for answers to their troubleshooting and product feature questions. Detailed video and audio explanations about products could be made available. Tapes could demonstrate a product's flexibility and applicability at different grade levels and could show teachers using the product with children, as well as sharing information about its uses with one another.

Print materials incorporating model lessons and traditional curriculum guidance such as pre and postcomputer lessons would be valued by technology-using teachers. Newsletters or booklets highlighting the latest hardware and software would address the chronic need of teachers to keep current technology.

Conclusion

Training must remain a priority in order for special educators to successfully incorporate technology into their curriculum. This vast need can only be met through contributions from all training sources: higher education, state and local education agencies, private trainers, and last, but not least, commercial publishers and producers. Direct and indirect support of technology training must become a national goal.

Resources

FDLRS/TECH, 2700 St. Johns St., Melbourne, FL 32940-6690; 407/631-1911.

MECC, 3490 Lexington Ave. N., St. Paul, MN 55126; 612/481-3500.

Mindscape, Inc., 3444 Dundee Rd., Northbrook, IL 60062; 312/480-7667.

Oregon Technology Access Program, 1871 NE Stephens, Roseburg, OR 97470; 503/440-4791.

Sunburst Communications, 101 Castleton St., Pleasantville, NY 10570-3498; 800/627-8897.

Teacher Support Software, 1035 N.W. 57th St., Gainesville, FL 32605-4483 ; 800/228-2871.

Tom Snyder Productions, 90 Sherman St., Cambridge, MA 02140 ; 800/342-0236.

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Editors:
June Behrmann
Elizabeth Lahm

The following reports are available upon request:

Volume 1, Numbers 1-3
Trends '88: Federal Commitment High
Adaptive Hardware '88
Special Education Costs & Demographic Data

Volume 2, Number 1
Trends '89: Hardware Design Characteristics

Volume 3, Number 1-2
Advancing the Use of Technology
Research Highlights on Technology Integration

This report was developed under Contract No. 300-87-0115 with the Office of Special Education Programs, U.S. Department of Education. The views expressed are those of the writers and do not necessarily reflect the position of OSEP/ED. No official endorsement of the material should be inferred.

Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Spring 1991 Vol. 4 No. 1

UPDATE: 1990 DEMOGRAPHIC DATA

Congress Learns About Who Is In Special Education

School age children between ages 6 and 17 who are receiving special education and related services continues to rise, the U.S. Congress was told in 1990.

Some 4.58 million children were counted under two federal special education laws for school year 1988-89. This marked an increase of 2.1 percent over the number served in 1987-88 and the largest increase since 1980-81 (See Table 1).

At nearly half of all children counted, the learning disabilities category grew 2.9 percent during 1988-89 over the previous count. While this has been typical growth for the last five years, over a ten-year period, learning disabilities jumped by 152 percent, according to the *Twelfth Annual Report to Congress on the Implementation of the Education of the Handicapped Act (EHA).* [The EHA was recently renamed the Education for Individuals with Disabilities Education Act in the 1990 amendments signed into law in October 1990. All past references to the word "handicapped" will be changed to "disabilities," with the person identified before the disability, i.e., child with disabilities. This is the last annual report to be published where the word "handicapped" is used frequently.]

Children with speech or language impairments accounted for some 23 percent of the total count and a 1.4 percent increase was noted.

The categories of mental retardation, emotional disturbance, learning disabilities and speech/language account for 94 percent of all children served. The mental retardation count dropped, however, by 2.7 percent (See Table 2).

Table 1

Children Age 0-21 Years Counted Under EHA-B and Chapter 1 of ESEA (SOP):[1] Number and Percentage Change: School Year 1984-85 to 1988-89

School Year	Percent Change in Total No. Served From Previous Yr.	Total Served	EHA-B	ESEA (SOP)
1988-89	2.1	4,587,370	4,324,220	263,150
1987-88	1.6	4,494,280	4,235,263	259,017
1986-87	1.2	4,421,601	4,166,692	254,909
1985-86	0.2	4,370,244	4,121,104	249,140
1984-85	0.5	4,363,031	4,113,312	249,719

[1]These numbers include children 0-21 years counted under Chapter 1 of ESEA (SOP) and children 3-21 years counted under EHA-B. The totals do not reflect infants and toddlers 0-2 years served under Part H of EHA.

Source: U.S. Dept. of Education, Office of Special Education Programs, Data Analysis System (DANS).

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Funded by The Office of Special Education and Rehabilitative Services, U.S. Department of Education

Table 2

Students Age 6-21 Served Under EHA-B, by Handicapping Condition and Percentage Change from School Years 1987-88 to 1988-89

Handicapping Condition	Number	Percent of Population	Percent Change (1987-88 to 1988-89)
Learning disabled	1,973,291	49.3	2.9
Speech or language impaired	957,739	23.9	1.4
Mentally retarded	522,864	13.1	-2.7
Emotionally disturbed	336,760	8.4	0.6
Multihandicapped	65,096	1.6	2.2
Hard of hearing and deaf	41,049	1.0	3.5
Orthopedically impaired	41,514	1.0	2.2
Other health impaired	46,639	1.2	7.8
Visually handicapped	17,116	0.4	1.4
Deaf-blind	792	0.0	4.2
All conditions	4,002,860	100.0	1.6

Source: U.S. Department of Education, Office of Special Education Programs, Data Analysis System (DANS).

The only category with notable growth came in the "other health impaired category," which grew some 7.8 percent. There were also increases in children counted as deaf-blind at 4.2 percent, and in children with multiple handicaps at 3.5 percent.

Categories with small increases include emotional disturbance, hard of hearing and deaf, orthopedically impaired, and visually handicapped.

Educational Settings

P.L. 94-142 requires students to be educated with mainstream students in the "least restrictive environment" that is individually determined to be appropriate. In school year 1987-88, the majority of students received special education and related services in settings with students without disabilities, according to data from the Education Department (See Table 3). Of these, nearly 29 percent were educated in regular classes. Another 40 percent received assistance in resource rooms. Over 24 percent were served in separate classes in regular education buildings.

Special education placement patterns are known to vary considerably by handicapping condition. Students with learning disabilities or speech impairments most often are educated in regular classrooms or resource rooms. Nationally, 57 percent of students classified as mentally retarded were placed in separate classes in public school buildings, as were 45 percent of students with multiple handicaps.

Early Childhood/Preschool Growth

Under federal law, the needs of the very youngest children with disabilities are addressed through two growing programs. One is the Handicapped Infants and Toddlers Program (Part H of P.L. 99- 457) that gives funds to help states plan, develop and put in place a comprehensive interagency system of early intervention service for handicapped infants, toddlers and their families. The other program is the Preschool Grants Program (section 619 of Part B of P.L. 94-142) for children with disabilities ages three to five. Both federal programs have phase-in periods to allow several years to build or improve programs.

In the infants and toddlers program, states are facing concerns about categories of children who will receive services. Under law, states must deliver services to those with a diagnosed physical or mental condition that has a high probability of resulting in a developmental delay.

But there is discretion to allow states to serve children who are "at risk" of having developmental delays if early intervention services are not provided. Admission criteria for these children must be spelled out. Wide variation exists from state to state in defining this "at risk" population.

1989 was the third year for which special funding supported education for infants and toddlers with disabilities. Data released since the report show that all 50 states, five other jurisdictions and the District of Columbia planned to apply for the funds. An exact count of infants and toddlers served was not conducted.

Those served under the infants and toddlers program must have an Individualized Family Service Plan, a written document that must be based on a multidisciplinary assessment of the child. While similar in principle to the individualized education program required under P.L. 94-142, this one goes further by involving families in specific ways based upon their determined strengths and weaknesses. Technology can play a role in developing *in individualized plan under both laws.*

The Preschool Grants Program of P.L. 94-142 is designed to ensure a free appropriate public education for all children age three to five with handicaps. The same special education and related services regulations that apply to school age children apply to this group of preschoolers.

Helping preschoolers with handicaps presents unique challenges to school districts, the Education Department told Congress in the report, because the developmental needs of the children are unique and because school districts have not traditionally provided programs for this age group.

For this group, Congress included an extra $3,800 for each new child who was expected to be served by December 1, 1990. This incentive, as well as sanctions for failing to participate by 1991-92, was included to encourage the expansion of services, the report noted.

Table 3

Percentage of Children and Youth Age 6-21 Served in Different Educational Environments, by Handicapping Condition: School Year 1987-88

Handicapping Condition	Regular Class	Resource Room	Separate Class	Separate School	Residential Facility	Home/ Hospital
Learning Disabled	17.6	59.2	21.7	1.4	0.1	0.1
Speech Impaired	74.8	19.7	3.8	1.5	0.1	0.1
Mentally Retarded	5.7	24.0	57.6	11.4	1.0	0.3
Emotionally Disturbed	12.6	32.9	34.6	14.3	3.5	2.2
Hard of Hearing and Deaf	24.4	20.9	35.2	10.8	8.6	0.2
Multihandicapped	6.4	13.3	45.9	27.2	4.0	3.1
Orthopedically Impaired	27.8	18.0	31.8	13.2	1.0	8.3
Other Health Impaired	30.6	20.8	18.7	9.5	0.8	19.6
Visually Handicapped	37.7	25.6	20.8	5.4	10.0	0.6
Deaf-Blind	8.9	7.2	35.1	21.0	24.2	3.7
All Conditions	28.9	40.0	24.7	4.9	0.8	0.7

Note: Totals include data from the 50 States, District of Columbia, and Puerto Rico. Educational placements for children ages 3-5 are not reported by handicapping condition.

Source: U.S. Dept. of Education, Office of Special Education Programs, Data Analysis System (DANS).

Since December 1986, services have increased by 21 percent. Nationally, 262,442 children received services under two federally-supported preschool programs.

How Course of Study Compares With Non-disabled Peers

Because special education students take most high school courses in general education classes, the U.S. Department of Education argued that there is a compelling responsibility on regular educators to help prepare students with disabilities for productive adult lives after exiting from high school.

During school year 1987-88, for example, a majority of the 53 percent of special students who left school graduated with either a regular diploma (43 percent) or a high school certificate (11 percent). While some 27 percent of students with disabilities dropped out of school, the rate was notably higher for those with emotional disturbance.

As compared with peers who are not identified as disabled, special students earned three fewer credits altogether. By comparison, there were fewer academic credits and more in the way of vocational education, personal development and other courses.

Special education high schoolers earn a mean grade point average of 2.0 on a scale of 4.0 points, but fare better in special courses at 2.2 than they do in regular classes where the mean grade point average is 1.9.

Overall, students with disabilities earned 56 percent of their credits either at or above grade level; regular students earned 85 percent. Some 44 percent of regular education credits taken by special youngsters were at a remedial level, compared with 15 percent for students without identified disabilities. Special education students generally took both math and science in remedial classes. English and social studies were taken on or above grade level.

Most special students take regular vocational education coursework. Performance varies, however, depending upon the type of disability and its severity. Black and Hispanic students earned fewer vocational credits than did their white peers or students of other ethnicities, the report said.

On Improving Services

Annually, state education agencies are required to assess various service delivery needs. In this report a majority (33) of states expressed concerns that vocational education programs and student transition to appropriate post-secondary experiences are a problem. Work-study options, job counseling opportunities, skill development, career awareness, and vocational training all need improvement, the states told the Education Department.

These special educators worry that students with disabilities are not prepared adequately and don't develop transferable skills needed for adult independence. Several states reported that better quality pre-vocational and vocational courses are needed, and that students need exposure to jobs as part of their curriculum. This need is especially compelling in rural areas where job opportunities are limited, the report noted.

Educators also expressed frustration about the lack of collaboration existing across agencies of the state. As a result, student programs lack coordination of a full range of needed services. Moreover, the lack of personnel of all kinds hinders progress. There also is a great need for various types of training materials.

Finally, educators told the government they currently lack appropriate assessment tools, especially for preschoolers and culturally- and linguistically- different students. States also reported that they are searching for better ways to evaluate the effectiveness of special education programs, including the quality of services and instructional programs.

Anticipated Services

The services most needed by students leaving school varied considerably by disability. For school year 1987-88, states ranked vocational/training/placement services as most needed, especially by students with mental retardation.

Counseling and guidance were needed by exiting students with visual and emotional handicaps, health impairments, and learning disabilities.

Transition continues to be an important interest of the federal government and schools nationwide. The enactment of new legislation that will affect the work special students will be moving into is raising hopes that more young people will be accommodated in mainstream America at work and in their communities during the next decade.

The New ADA

On July 26, 1990, President George Bush signed into law the American with Disabilities Act (ADA), P.L. 101-336. This is seen by advocates for the disabled as the most expansive civil rights law affecting persons with disabilities in the private sector that has been enacted in the past 25 years. It also requires a range of accommodations in various public settings, private schools and day care centers, and specific new accessibility requirements relating to transportation and telephone equipment.

ADA ensures that people with disabilities are given the basic guarantees to independence, freedom of choice, control of their lives and the opportunity to blend equally and fully into the American mainstream, President Bush said when he signed the law before 2,000 invited persons with disabilities.

References

U.S. Department of Education, Office of Special Education Programs (1990). To assure the free appropriate public education of all handicapped children. *Twelfth annual report to Congress on the implementation of the Education of the Handicapped Act.* Washington, DC: Author. (Single copies of the Twelfth Annual Report are free from the Office of Special Education Programs, U.S. Department of Education, Switzer Building, Room 3529, 330 C Street SW, Washington, DC 20202.)

Legislation

Elementary and Secondary Education Act. Chapter 1. State Operated and Supported Schools. P.L. 89-313. This authorizes federal aid to meet the specialized educational needs of children with handicapping conditions who are enrolled in state operated and supported programs.

The Education of the Handicapped Amendments of 1986, P.L. 99-457. This act amends the Education of the Handicapped Act (P.L. 94-142) by creating Part G to assist the development and advance the use of new technology, media, and materials in the education of handicapped students and early intervention for infants and toddlers. Goals include enhancing availability, improving quality, and encouraging the appropriate use of technology.

Americans with Disabilities Act (ADA) of 1990, P.L. 101-336. This law extends civil rights protections to the disabled in the private and public sectors with regard to employment, transportation, public accommodations, and communications. (Information and fact sheets on the ADA are available by calling the U.S. Department of Justice telephone hotline at 202/514-0301 from 11:00 a.m. to 5:00 p.m. Eastern Standard Time or by writing to U.S. Department of Justice, P.O. Box 6618, Washington, DC 20035-6118.)

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Volume 3, Numbers 1-3:
Advancing the Use of Technology
Research Highlights on Technology Integration
Technology Training

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Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Summer 1991 Vol. 4 No. 2

NASA-Developed Technology for Students with Disabilities

An expert panel of special educators this spring presented the first of two technology-related problems to the National Aeronautics and Space Administration (NASA) in hopes of improving the education of students with disabilities.

The educators, working through the Center for Special Education Technology at the Council for Exceptional Children (CEC) and the North Carolina-based Research Triangle Institute (RTI), tapped into an unique NASA Technology Utilization Program that enlists the help of commercial sector partners to reengineer technology from the space program to help people on earth.

Educational Problems

From a long list of student problems for which the educators want to see technology-related solutions, three were chosen as priorities following two audio teleconferences held last fall and after colleagues met at a special session at CEC's Technology and Media Division's annual conference in Kansas City last January. Two of the three problems were deemed appropriate for referral to NASA's applications engineers.

- The first seeks simplification of the monitoring and life support of medically fragile, technology-dependent children in educational settings.
- The second asks for computerized tutorial assistance that develops literacy skills for severely challenged nonverbal students with normal cognitive functioning.
- A third problem, considered equally as compelling as the others, the need for portable speech devices, did not make the list after further inquiry showed that several commercial firms are currently developing this technology.

Educators say portable speech devices would be a way to help children with disabilities fully participate in special and regular education with their peers. At present, the size and bulk of existing equipment limits such participation. As more and more very young children with disabilities are enrolled in early intervention programs, "portability" takes on new meaning. What is deemed portable for an adult user or even a school-age child, may not be portable for a 2 or 3-year old who could benefit from augmented communication.

While portable speech devices may still be many months or even years away, solutions to problems chosen as priorities for NASA will also take time. Those that are accepted will be considered by NASA's network of nine centers as activities in the 1992 or 1993 budgets.

NASA's Technology Utilization Program

Dean Hering and Steve Lehrman of RTI are helping the special educators define and present their problems to NASA. In addition, RTI's NASA contract calls for the Institute to aid technology transfer by seeking private sector partners to co-fund technology-related solutions. RTI then helps those companies bring the product to the marketplace.

One of the program goals is commercialization of products resulting from the Technology Utilization Program work. NASA wants to ensure that efforts to transfer technology have an impact on special education or other populations, Hering says.

The reengineering of space technology for earthbound uses comes from the Office of Commercial Programs as part of NASA's Technology Utilization Program, a 1958 mandate from the U. S. Congress to NASA, Hering explains. RTI has been involved in the process for 26 years.

To help the technology transfer along, the RTI Applications Team seeks and helps to assess which problems presented by public service organizations like the Center for Special Education Technology are amenable to applications from aerospace technology. When a match is made between the problem and NASA technology, Technology Utilization Officers at each of the nine NASA Field Centers coordinate activities among the centers. Along the way, RTI consults with business and industry, universities, and federal and state agencies as it pursues the technology transfer.

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Funded by The Office of Special Education and Rehabilitative Services, U.S. Department of Education

Private Sector Partnerships

When solutions appear promising, NASA joins with private companies and other organizations in a formal Applications Engineering Project through letters of agreement or joint endeavor contracts.

NASA provides technical assistance, shares costs, and protects rights to new discoveries for the private sector firms involved, according to Hering. These firms receive clear-cut guidance about responsibilities, tasks, schedules, and milestones expected during development phases, as well as policy, proprietary interests, co-funding arrangements, and paperwork requirements. NASA says clear specifications help to minimize barriers to private sector participation.

In most cases, final product development, field testing, and marketing are managed by private companies without NASA's involvement, Hering notes.

Special Education Problem Statement

The following statement explains one of the two special education technology-related problems now being developed for NASA's consideration. It was devised by a group of special educators headed by Gayl Bowser, an assistive technology specialist at the Oregon Department of Education's Division of Special Education: Technologies are needed to provide and enable modularization, integration, and portability of medical monitors and life support units for children in order to reduce the management requirements of multiple system operation.

"Some sources estimate that as many as 100,000 infants and children may be in some way technologically dependent," Bowser and her colleagues note in their proposal to NASA.

Increasingly, these students whose conditions are referred to as "medically fragile" are being educated in schools rather than in hospitals or at home. They have complex medical monitoring and life support needs. Parents and school staff must learn to operate a variety of equipment usually found only in medical facilities.

Among the monitoring devices are apnea monitors, devices that monitor heart rate, oxygen saturation, fluid retention, and seizures. Life support systems include those that provide nutrition, ventilation, suction, medical drips, and dialysis.

In Practice

In preparing their report, the special educators told RTI:

> Children are often connected to several such devices which are then transported to and from school and into the community on family outings. There is a need for a single, modular monitoring device which can incorporate multiple devices in order to reduce the amount of equipment needed by an individual and still meet the child's medical needs. The device should allow for the addition or removal of monitoring and life support systems as the needs of the child change.
>
> Integrating these systems would reduce the number of single-purpose monitoring and life support systems needed by an individual child, significantly reducing the cost of patient care. Such a device would also reduce the complexity of care and allow care-providers who do not have medical training to care for medically fragile children with more confidence and independence.
>
> An integrated alarm management system would reduce the number and complexity of alarms and warning systems. The number of cables, tubes, and sensors could likewise be reduced.

The Mechanics

In current practice, teachers and related services personnel most frequently deal with life support systems, including ventilators, suctioning devices, and dialysis machines. They must also understand how to operate and sometimes maintain monitoring systems such as blood level monitors, heart rate and blood pressure monitors, apnea monitors, oxygen saturation monitors and EKG monitors.

The educators have found that one child could require several of these devices, each with its own tubes, cables, power supply, alarm system, and additional equipment or supplies.

A child needing two or more systems might have several items attached to his or her body, as well as extension cords or power supplies. These limit the student's ability to participate in activities of daily living.

Moreover, multiple pieces of equipment are confusing to those who care for the child at home, as well as in school or in the community. Alarm systems often sound similar making it hard to determine which device is signaling trouble. Once the problem is located, other pieces of equipment interfere with a swift resolution, they report.

Finally, multiple systems are expensive since each device ranges from $500 to $5,000. The modular equipment that exists in hospitals is bulky, expensive, and unsuitable for portable use, the educators note.

A Proposed Solution

Special educators would like to see a modular device that would integrate multiple monitoring and life support systems and allow additional equipment to be added on later. Supervisory hardware and software must be included.

A single alarm management system is needed that would provide a print read-out telling caregivers which system is alarming and provide guidance about remedial actions needed. An integrated power distribution system is desirable.

Along with the problem statement and background, the educators and RTI Applications Team recommended other desirable features or solutions. These include:

- Lightweight batteries.
- More efficient electronics to reduce power consumption.
- Wireless telemetry to untether the child from physical monitoring systems.
- A human factors design of displays and control systems that gives clear, concise information.
- Common bus arrangements to facilitate plug-in capabilities.
- Hardware and software to control multiple alarm and control systems.
- New technical methods to improve the accuracy of existing functions of individual devices or to allow functions of two devices to be combined in a single module.

In Summary

The opportunity to become involved in the possible transfer of NASA-developed technology to special education has been a valuable and challenging experience for all concerned. We are hopeful that other special educators will become involved in such efforts, and that those who develop and produce technology-based products will consider the needs and the potential of students with disabilities.

Education Team

The special educators who are participating in the NASA project include:

* Gayl Bowser, Oregon Department of Education
* Warren Brown, Instructional Technology Technical Resource Unit, Florida
* Mary Cole, Assistive/Adaptive Device Coordinator, Texas Education Agency
* Susan Elting, Center for Special Education Technology, Virginia
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Center for Special Education Technology

The Marketplace

Report on Technology in Special Education

Fall 1991 Vol. 4 No. 3

SPECIAL EDUCATORS PROBE PROMISES AND PITFALLS OF MULTIMEDIA TODAY

Special educators want systematic answers to questions about investing in multimedia so a group of experienced users met in Washington, D.C. last June to examine the hopes, fears, opportunities, and possible next steps involved in bringing more integrated technologies into schooling.

At the seminar convened by the Center for Special Education Technology experts from across the country discussed learning theory, applications, and problems associated with educational interactive multimedia. All participants felt this was an exciting new media to help special learners communicate.

Participants, who are researchers and teacher trainers, also raised questions about the possibilities and pitfalls of instruction of students with disabilities that arise when graphics, sound, video, and text are linked and infused into instruction.

In its advanced forms, "hypermedia" software enables the multimedia to run as interconnected systems. To date, state-of-the-art equipment is found in only 9% of U.S. schools. In simpler forms, without the computer and with highly structured teaching, multimedia has historically been part of effective special education.

Based upon this experience, special educators see promise in the advancing technology, especially as costs come down. An increase in federal special education funding for the 1991-92 school year could mean more dollars would become available for technology purchases in some school districts.

More about multimedia's contribution to learning needs to be known, the researchers noted. Decision-makers do not yet understand what multimedia can do for special students, whether it is as accessible as it should be, or if its expense is justifiable.

Multimedia and Learning

Keynote speaker, John Bransford of the Learning Technology Center at Peabody College of Vanderbilt University, advocated that with multimedia "we have the opportunity to break the mold" and go beyond embellishing the curriculum. Multimedia tools permit the teacher and learner to interact in new ways.

The teacher's goal of helping the student become an independent thinker and learner can be achieved as the student actively becomes involved with the content presented through multimedia. No longer is the recall of facts sufficient; the focus is on thinking, applying information to new situations, and solving problems.

What can be done with multimedia to help the student learn, and transfer these skills to new situations? The answer lies in giving students opportunities to engage in activities that support these outcomes. Give students time to explore a few topics in depth and allow students to see potential applications. Present interesting, realistic problems to solve, encourage students to explore ideas of interest to them, and offer opportunities to collaborate and present their work to others.

Attention to ways the learner knows where he or she is in the multimedia program, and incorporation of video on the computer screen instead of on an adjacent screen, will increase the effectiveness of multimedia, according to Ted Hasselbring of Peabody College. These new developments will be especially welcomed by learners who are disabled and frequently lost or distracted as they "navigate" in multimedia.

Applications

Real life activities give meaning to a problem-solving environment. Students are in an apprentice-type environment when, together with their instructors, they experience events such as those depicted in the *Jasper Series*, available on laserdisc. In this program students view Jasper's adventures and discuss solutions to his problems using their science and math skills, along with observation and logical thinking skills. Classrooms in 17 states that have worked with Jasper get together for

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challenge sessions through telecommunications, and they share a newsletter.

Multimedia Composer is an example of integrated media that students use to create a composition using text, video pictures, sounds, maps, and timelines. They often begin a composition with pictures or with sounds. Tony Peacock from IBM confirmed that LD kids like to organize information first by sounds when they use the National Geographic program *Mammals*.

Another application that "breaks the mold" is an adult literacy program used at Peabody College. The comprehension part of this program uses video, instead of a dictionary, to convey the meaning of words the student would usually look up in the dictionary. With this understanding of new words and concepts from the video, students are ready to identify correct passages on the screen.

A student with a disability finds a variety of inputs and outputs, such as print or voice, are useful. The variety of ways to access information and the variety of production formats is especially important for students who have difficulty with print related skills. Ted Hasselbring noted research indicating that information available in multiple ways leads to better retention and retrieval.

GTV, A Geographic Perspective of American History, is a laserdisc program by National Geographic that ignites students as they create their own show, decide what is important and what should be included in the show. The technology's capabilities provides a springboard for their imagination. Suddenly the power of commercial video is available for education.

Delphi Study

In a formal examination of the issues surrounding the use of multimedia, the Center for Special Education Technology identified three primary areas of concern that special educators want researched:

- Analysis of effective instructional and multimedia design, the most frequently identified category.
- How individual differences and disabilities affect efficacy.
- Identification of training and resources that are key to making multimedia available and effective.

Because there is very little completed research on the efficacy of multimedia in special education on which to plan or base decisions, the Center collected opinions of experienced multimedia users by conducting a "Delphi Study."

Using successive questionnaires, information was gathered from individuals who currently are conducting research in special education technology or are knowledgeable on the topic.

At each stage, respondents received feedback about results from prior questionnaires to clarify points of agreement and disagreement in the community.

Delphi studies often are used when informed opinions may be more valuable than hard data or when adequate information about a topic is unavailable or difficult to get. The study was analyzed by Ralph Ferretti of the University of Delaware.

"The study was remarkably successful in detecting consensus about important multimedia research issues," Ferretti notes.

Help or Hindrance?

Experts are concerned about multimedia design and instruction. Should research be undertaken, they want to know if multimedia can enhance instructional strategies. Special educators wonder, for example, in what ways collaborative learning is affected by using multimedia.

Other potential research questions included the following:

- Which instructional practices can be enhanced by multimedia?
- How does multimedia aid in the acquisition of knowledge and skills among various special education populations?
- What characteristics of multimedia contribute to important academic and motivational outcomes?
- What new ways of learning does multimedia suggest?
- What design principles should be followed in the development of multimedia applications?
- How much and what kinds of media use contribute to effective learning?

Special educators are especially interested to know if multimedia can promote the transfer of learning from one area to another and if skills acquired by users will generalize to other learning environments and settings. Their hope is that technology can help students recognize learning conditions and apply skills correctly to solve problems.

Research is needed to give evidence on ways multimedia makes learning meaningful and can help students overcome obstacles to the transfer of learning they now encounter, according to Ferretti's report.

Guarded Optimism

If multimedia presents problems, beyond the cost of the technology, special educators see a danger in its vastness and complexity. Students with special learning needs can too easily become disoriented as they roam in what Ferretti calls "problem space." Negotiating electronic sources that are linked together, while wonderfully motivating and provocative, can be demanding intellectually – perhaps too demanding.

Specifically, educators want to know what "navigational aids" can help special students stay on course. These built-in features would help students know where they have come from and where they are going. Such aids, in the form of electronic guides, instructions, the use of sound, etc., would cue children who might get lost in "semantic space."

Educators are also curious about the effectiveness of multimedia in light of student differences in cognitive skills, physical and sensory characteristics, and learning styles. Special educators are asking if the technology is accessible to a wide range of learners, but also sensitive and adaptable to individuals.

Logistics and Skill Factors

Finally, respondents in the study wanted to learn more about how a teacher's skills and access to technology relate to the use of multimedia in schools.

More information is needed about a school's overall goals, the perceived value of technology to meet those goals, and the teacher's skillfulness in using media to meet those ends.

A final area of inquiry would explore questions about where technology is best placed within the system, in regular or special education, for example. Such logistical factors, along with design and population analyses, are the most fruitful for study in the opinion of a group of 18 experts of 48 polled.

Future Dialogues

Many questions remain about the future of multimedia in schools. Teaching and learning are changing. Integrated media is not yet infused into practice.

While there are notions that multimedia holds promise to improve learning, these are tempered by questions about its accessibility for a wide variety of learners and ability to account for individual needs.

Special educators are in a unique position to advise developers who are upgrading and improving their products. Developers need to respond by listening carefully. Researchers and developers can work together to shape the direction of multimedia development.

Formal organized interaction is needed among groups so that research and development go hand-in-hand. As a first step, issues raised in the study will be shared with the U.S. Department of Education for use in determining future research priorities concerning special education and technologies.

Multimedia Resources

The Center is publishing a proceedings document and a bibliography that will be available this fall as it completes its four-year contract with the U.S. Department of Education. To receive a free copy, contact the Center.

Proceedings, Multimedia Technology Seminar. (1991). Reston, VA: Center for Special Education Technology. (115 pages)

This proceedings document is a product of the Center's May 1991 Technology Seminar on Multimedia. Included are papers submitted by panelists at the symposium. These papers focus on emerging multimedia technologies and potential applications for special needs learners. In addition, the results of the Center's Delphi study to identify multimedia research questions are presented and followed by a discussion on the implications for future research.

Desk Reference, Multimedia Technologies. (1991). Reston, VA: Center for Special Education Technology. (30 pages)

This document is designed to serve as a reference tool for researchers on the topic of emerging multimedia technologies. It includes literature, with an annotated bibliography of selected references in multimedia, and brief descriptions of major multimedia research and development projects.

Multimedia Applications

The Adventures of Jasper Woodbury. 4 episodes. 1988-1991. Learning Technology Center, Vanderbilt University, Peabody College, Nashville, TN 37203; 615/322-8070.

Mammals: A Multimedia Encyclopedia. 1991. Optical Data Corp., 30 Technology Drive, Warren, NJ 07060; 800/524-2481.

Multimedia Composer (in development). CAST, Inc., 39 Cross Street, Peabody, MA 01960; 508/531-8555.

Peabody Multimedia Adult Literacy Program (in development). Learning Technology Center, Vanderbilt University, Peabody College, Nashville, TN 37203; 615/322-8070.

GTV: A Geographic Perspective on American History. 1990. Optical Data Corp., 30 Technology Drive, Warren, NJ 07060; 800/524-2481.

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